SYLLABUS
BICD 101: Eukaryotic Genetics Laboratory
Summer Academy 2017

Instructor:
Prof. Laurie Smith lgsmith@ucsd.edu (office hours during class, or by appointment)

Instructional Assistants:
Susanne Matschi (postdoc in Smith lab) smatschi@ucsd.edu
Belinda Hui (UCSD masters student) behui@ucsd.edu
Albert Nguyen (UCSD graduate June 2017) amn026@ucsd.edu
Amanda Calimlim (UCSD undergrad; Summer Academy 2016 alumna) arcaliml@ucsd.edu

Website: https://tritoned.ucsd.edu/webapps/login/ (all required readings will be posted here)

Overview: In this class, we will use cutting edge quantitative genetics methodology to identify regions of the maize genome controlling cuticle function as a barrier against water loss, a trait related to drought tolerance. Prior work in the Smith lab has determined that “cuticular evaporation” (CE) rate (rate at which water is lost under conditions where stomata are closed, via evaporation across the cuticle) varies across genetically diverse inbred lines of maize, and that this trait is heritable. This sets the stage for our genome-wide association study (GWAS) to identify the genomic regions (and candidate genes in those regions) contributing to genetic control of CE rate. The experiments we will do in this class will be a critical part of an ongoing project funded by the U.S. National Science Foundation entitled “Genomic Analysis of Leaf Cuticle Developmental and Functional Diversity in Maize” led by Professor Smith with collaborators at Cornell and Algoma Universities and the USDA Arid Land Agricultural Research Station.

Learning and Course Goals:
• Students will achieve a basic understanding of quantitative genetics methodology and concepts including knowledge about quantitative and complex traits, heritability, inbreeding, identification and use of DNA polymorphisms to assess genotypic variation in a population, association analysis (GWAS), and uses of GWAS in plant breeding as well as in human genetics
• Students will develop computational skills, primarily use of Excel to perform statistical tests, generate graphs, and use functions to draw conclusions from large datasets. Students will use other software to identify correlations between genotype and phenotype in large datasets (i.e. perform association tests).
• Students will acquire experience DNA extraction, polymerase chain reaction, agarose gel electrophoresis, preparation of DNA for sequencing, and computational analysis of DNA sequence to identify single nucleotide polymorphisms (SNPs)
• Students will gain experience with interrogation of genome sequence databases
• Students will have the experience of participating in an original research project whose outcome is unknown
<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture (all groups) 12:30-1:30 pm, York 3010</th>
<th>Phenotyping/Lab Work (1:30-5:30), York 4124</th>
<th>Journal Club (1:30-2:30, York 3010)</th>
<th>Computer Work (York 3020 2:30 start unless indicated otherwise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 7 Monday</td>
<td>Class overview</td>
<td>Demo; field visit (all)</td>
<td>None</td>
<td>None</td>
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<tr>
<td>August 8 Tuesday</td>
<td>Cuticles and drought tolerance</td>
<td>Trial run (all groups)</td>
<td>None</td>
<td>None</td>
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<tr>
<td>August 10 Thursday</td>
<td>Inbreeding and inbred lines</td>
<td>Phenotyping session 1 (groups 1-5)</td>
<td>Paper 1 (groups 6-10)</td>
<td>Excel/statistics basics (groups 6-10) Susanne</td>
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<tr>
<td>August 11 Friday</td>
<td>Nucleotide variation (SNPs and indels)</td>
<td>Phenotyping session 1 (groups 6-10)</td>
<td>Paper 1 (groups 1-5)</td>
<td>Excel/statistics basics (groups 1-5)</td>
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<tr>
<td>August 14 Monday</td>
<td>Semi-dominant inheritance; quantitative and complex traits</td>
<td>SNP discovery: DNA extraction; set up PCR reactions</td>
<td>None</td>
<td>None</td>
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<tr>
<td>August 15 Tuesday</td>
<td>Estimating heritability in model systems</td>
<td>SNP discovery continued: run gels; clean up PCR products; submit for sequencing</td>
<td>None</td>
<td>None</td>
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<tr>
<td>August 17 Thursday</td>
<td>Recombination and linkage</td>
<td>Session 2 (groups 1-5)</td>
<td>Paper 2 (groups 6-10)</td>
<td>Analyze sequence (SNP discovery) groups 6-10</td>
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<tr>
<td>August 18 Friday</td>
<td>Linkage disequilibrium</td>
<td>Session 2 (groups 6-10)</td>
<td>Paper 2 (groups 1-5)</td>
<td>Analyze sequence (SNP discovery) groups 1-5</td>
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<tr>
<td>August 21 Monday</td>
<td>GWAS</td>
<td>None</td>
<td>SNP calling (all groups; 1:30 start)</td>
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<tr>
<td>August 22 Tuesday</td>
<td>Lab report discussion</td>
<td>None</td>
<td>Work on lab report 1 (all groups; 1:30)</td>
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**August 24**  
Hand in Lab Report 1 beginning of class

<p>| August 24 Thursday | Candidate gene evaluation in model systems (no quiz) | Phenotyping Session 3 (groups 6-10) | None | Calculation of drying rates (groups 1-5) |
| August 25 Friday | Marker-assisted and genomic selection             | Phenotyping Session 3 (groups 1-5)   | None | Calculation of drying rates (groups 6-10) |</p>
<table>
<thead>
<tr>
<th>Monday August 28</th>
<th>Human GWAS I: overview and SNP genotyping</th>
<th>Phenotyping Session 4 groups 6-10</th>
<th>Paper 3 (groups 1-5)</th>
<th>Analyze associations I (groups 1-5)</th>
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<tbody>
<tr>
<td>Tuesday August 29</td>
<td>Human GWAS II: case studies</td>
<td>Phenotyping Session 4 groups 6-10</td>
<td>Paper 3 (groups 6-10)</td>
<td>Analyze associations I (groups 6-10)</td>
</tr>
<tr>
<td>Thursday August 31</td>
<td>Human GWAS III: candidate gene evaluation</td>
<td>None</td>
<td>None</td>
<td>Analyze associations II (all groups; 1:30 start)</td>
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<tr>
<td>Friday Sept. 1</td>
<td>Human heritability (with guest Dan Gustavson; no quiz)</td>
<td>None</td>
<td>None</td>
<td>Human heritability calculation (Dan Gustavson)</td>
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<tr>
<td>Monday Sept. 4</td>
<td>LABOR DAY: no class</td>
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<tr>
<td>Tuesday Sept. 5</td>
<td>Human GWAS IV: health impacts</td>
<td>None</td>
<td>Paper 4 (all groups; 1:30-2:30)</td>
<td>Identify candidate genes (all groups; 2:30 start)</td>
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<tr>
<td>Thursday Sept. 7</td>
<td>Class presentations on candidate genes (no quiz)</td>
<td>None</td>
<td>None</td>
<td>Investigate the functions of candidate genes (all groups; 1:30 start)</td>
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<tr>
<td>Friday Sept. 8</td>
<td>None (no quiz)</td>
<td>None</td>
<td>Work on lab reports (all groups; 12:30 start)</td>
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<tr>
<td>Sept. 9</td>
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<td>Hand in Lab Report 2 by 10am York 3020</td>
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**Required Safety Training:**
Students must successfully complete the Biology Lab Safety Training and Assessment before the first lab session: [https://dbsportal3.ucsd.edu:3443/safety-training/](https://dbsportal3.ucsd.edu:3443/safety-training/).

**Attendance Policy:**
Attendance on the first two days is absolutely required to participate in the course. Arrival more than 15 minutes late counts as an absence. If the class is dropped after the end of the second class meeting (after 6pm Aug. 8th), there will be a “W” on your transcript for this class. After the second class meeting, up to two absences will be allowed (the first may be unexcused i.e. no questions asked or excuse needed; the second must be excused on the grounds of a medical or personal issue beyond your control, to be discussed with the instructor and/or documented. If you are absent (or more than 15 minutes late, or leave before class is dismissed) more than twice, you will be asked to drop the class (with a W, after the second class meeting).
Assessments:
Lab report 1 60 points
Lab report 2 60 points
Quizzes 32 points (8 four point quizzes - see more info below)
Journal club participation 24 points (see more info below)
Attendance, class participation, miscellaneous assignments 24 points

Grading Scale:
A = 180-200 points
B = 160-179 points
C = 135-159 points
D = 100-134 points
F < 100 points

Quizzes
Most days beginning Aug. 8, class will begin (first 15 minutes) with a short quiz consisting of one or two questions based on the lecture the day before (but note below under “journal club” that some quizzes will be on the assigned reading instead). All students will have their lowest two quiz scores dropped automatically, but there will be no opportunity for makeup quizzes. If you miss class with or without an excused absence (see section on policies regarding absence from class), and are therefore not able to do well on the next day’s quiz, that will presumably be one of your dropped quizzes. If you are late to class, you may start the quiz when you arrive but will have to hand it in when time is called even though this means you had less time than other students. Be on time!!

Office Hours
All students in the class will be scheduled for one-on-one “office hours” discussions with Prof. Smith during class time (schedule to be determined). Active participation in these sessions, including bringing questions and concerns for discussion, will be part of your class participation grade. This will be an opportunity to earn back missed quiz points, if the conversation creates and/or demonstrates a better understanding of the topic than your quiz answer did. Students are warmly invited to speak with Prof. Smith at any time during a lull in class activities (or after class), likewise with the Instructional Assistants, without an appointment. We are here to help you – take advantage of us!

Lab Reports
Lab reports will report your data analysis along with background and interpretation. Detailed guidelines will be distributed prior to the due date of each lab report, and you will have time to work on them in class. While discussion and sharing of information and ideas with other students in the class is encouraged, and some of the data and analysis to be presented will reflect the work of others in addition to your own, the reports themselves must be your own work in your own! 10 points will be deducted for each day that a lab report is late.

Academic Integrity:
Integrity is essential for success in this class, as in science, as in life. We have every expectation that all students in this class will work with integrity, however a student who
does not (e.g. appears to have copied another student’s work on a lab report or quiz, or altered a quiz answer and then asked for it to be re-evaluated) will be reported to the Academic Integrity Office. A student found responsible for academic dishonesty will receive an F as their final grade in the class in addition to any penalties imposed by AIO.

Journal Club
Each group of students will participate in four journal club discussions during the second hour of class on scheduled dates. All students are expected to read the assigned articles as homework before class (these will be posted on the course website and should not take more than an hour or so to read) and come to class prepared to participate in a discussion of the reading. On journal club days, quizzes for groups participating in journal club will test basic knowledge of the assigned reading rather than the previous days’ lecture.

Paper 1: Ristic, Z. and Jenks, M.A. (2002). Leaf cuticle and water loss in maize lines differing in dehydration avoidance. *J. Plant Physiology* **159:**645-651. This paper presents an early study comparing cuticular evaporation rates in a pair of inbred lines of maize with different degrees of drought tolerance. Our cuticular evaporation assay is based on theirs.

Paper 2: Hansey, C. et al. (2012). Maize genome diversity as revealed by RNA-sequencing. *PLoS One* **7:**e33071. This paper presents data on sequence variation within a collection of genetically diverse inbred lines of maize. It illustrates how sequence variation is discovered, and the degree of variation between different maize inbreds. Focus on the Abstract, Introduction, and Results and Discussion sections with headings Description of Germplasm and Datasets and Single Nucleotide Polymorphism Variation (Table 1, Figures 1 and 2).

Paper 3: Scuteri, A. et al. (2007). Genome-wide association scan shows genetic variants in the FTO gene are associated with obesity-related traits. *PLoS Genetics* **3:**e115. This study published 10 years ago is one of many reporting a strong association between SNPs in the FTO gene and obesity in humans. Focus on the Abstract, Author Summary, Introduction, Results section through the last complete paragraph on pg. 1203 (Figures 1, 2A, 3A; Tables 1 and 2), and the Discussion.

Paper 4: Postmus, I., et al. (2014). Pharmacogenetic meta-analysis of genome-wide association studies of LDL cholesterol response to statins. *Nature Communications* **5:**5068 (figure out this citation – very confusing). Illustrating one of the applications of GWAS to human health, this paper illustrates the use of GWAS to identify SNPs that could be used to predict responsiveness to cholesterol-lowering statins. It exemplifies the emerging field of pharmacogenetics (consideration of genetic factors in designing drug treatment plans). Concentrate on the Introduction, Results (except the last section with the heading “Functional analyses”) and the Discussion. You do not need to read the Methods section!!
UCSD Student Resources (not specific to this course!!)

Academic support resources:

Teaching and Learning Commons at UCSD (http://commons.ucsd.edu/students/index.html). Many resources here for students including:

- Supplemental Instruction. Scheduled sessions to support students in classes that many UCSD students find challenging – see list of supported classes and schedules at (https://commons.ucsd.edu/students/supplemental-instruction/index.html)

- Triton Achievement Partners. Drop-in tutoring during the academic year for lower division math and chemistry courses. See https://commons.ucsd.edu/students/math-science%20tutoring/index.html#Math-and-Chemistry-Tutoring and you can send enquiries to tritonachievementhub@ucsd.edu.

- Writing and Critical Expression Hub. See http://commons.ucsd.edu/students/writing/index.html. Writing mentors on staff (including some biology expertise and training in science writing) work with students to improve their writing skills while working on class writing assignments (e.g. lab reports!) and other writing projects. See their drop-in hours, and options for appointments.

OASIS: Office of Academic Support and Instructional Services also offers tutoring, writing and mentoring support – see https://students.ucsd.edu/sponsor/oasis/). Each year, OASIS serves 3,000 students in language, math, science, study skills, and writing as well as peer counseling and peer mentoring. Located on the third floor of Center Hall, (858) 534-3760, oasis@ucsd.edu.

Health and community resources (in alphabetical order):

Black Resource Center: a campus community center that serves everyone at UC San Diego while emphasizing the Black experience. Promotes scholarship, fosters leadership, and cultivates community through the committed, collaborative effort and support of faculty, staff, and the broader UC San Diego community. http://brc.ucsd.edu/

Counseling and Psychological Services (CAPS) provides FREE, confidential, psychological counseling and crisis services for registered UCSD students. CAPS also provides a variety of groups, workshops, and drop-in forums. See http://caps.ucsd.edu/ and/or call (858) 534-3755.

Cross-Cultural Center: strives for meaningful dialogues and context across all cultures, particularly those of underrepresented or underprivileged backgrounds. Offers supportive
and educational services through art, social and educational programs, workshops, and outreach. Welcomes creative venues for enhancing social consciousness and equity. 
http://ccc.ucsd.edu/

LGBT Resource Center: provides a visible presence on campus and enhances a sense of connection and community among LGBT faculty, staff, students, alumni and the UC San Diego Community. http://lgbt.ucsd.edu/

Office for the Prevention of Harassment & Discrimination (OPHD): provides assistance to students with concerns about bias, harassment, and discrimination. UCSD is committed to upholding policies regarding nondiscrimination, sexual violence and sexual harassment. Students have options for reporting incidents of sexual violence (e.g. sexual assault, dating violence, domestic violence, and stalking) and sexual harassment. Information about reporting options may be obtained at OPHD at (858) 534-8298, ophd@ucsd.edu, or http://ophd.ucsd.edu. Students may also receive confidential assistance at the Sexual Assault Resource Center at (858) 534-5793, sarc@ucsd.edu, or http://care.ucsd.edu.

Office for Students with Disabilities (OSD) works with students who have documented disabilities to provide reasonable accommodations. See https://disabilities.ucsd.edu/about/index.html; call 858.534.4382 and/or email osd@ucsd.edu. Students in need of disability accommodations for a UCSD course must provide their instructor with a current Authorization for Accommodation (AFA) letter issued by OSD. If you have an AFA, please arrange to meet privately with me during the first week of the quarter so we can discuss your accommodation. If you have any questions or concerns about a disability, please discuss with me!

Raza Resource Centro: a lively space where students study, meet, write, get tutoring, and most importantly are in community. It is a space where Latina/Chicano organizations hold meetings, events and where culture, arte, and academics interconnect. http://raza.ucsd.edu/

Student Veterans Resource Center (SVRC): supports military-affiliated students in making the transition to campus life and facilitating their progress toward degree completion. The Center also provides opportunities for peer-to-peer support, mentoring and social networking. See https://students.ucsd.edu/sponsor/veterans/

Women’s Center: serves as a resource for the entire campus community while placing the experiences of diverse women at the center through the resources provided, the programming and learning opportunities facilitated, and the dynamic community space created. https://women.ucsd.edu/

*There are many other resources available to you on campus. If you want to know more about where you can go for support, please let me know and we can find it together!*